

**ABSTRACT**

The art has experienced difficulty obtaining "sound" welds with high-nickel welds above the second pass. Particular problems are tension anomalies and sub-optimal interweld pass fusion at higher order passes of the weld wire, along with undesirably high heat levels transferred to the workpiece. The inventors have discovered that ductile iron-to-ductile iron welds can be reliably formed at mission-critical junctures by compensating for the brittle nature of the heat affected zone through enhancing ductility of the weld itself. The present invention provides in continuing part for a highly durable weld without soundness problems such as tension anomalies, multilayer fusion imperfections, or pinholes; and a method of forming such a weld. The weld is created using high nickel weld wire (filler metal or consumable electrode, or both) welded in a pure inert gas (or mixture of pure inert gasses and even reducing gasses). Additions of weld metal alloys, flux coring, and deoxidizing coatings are not required. The work pieces do not require pre- or post-heat treatment to minimize the effects of the HAZ. Additional inventive features are described more fully below.

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